PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-015592
(43)Date of publication of application : 25.01.1994

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(51)Int.Cl. B25J 18/02

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(22)Date of filing : 21.04.1993 (72)Inventor : GRUNES HOWARD

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(30)Priority

Priority number : 92 873422 Priority date : 23.04.1992 Priority country : US

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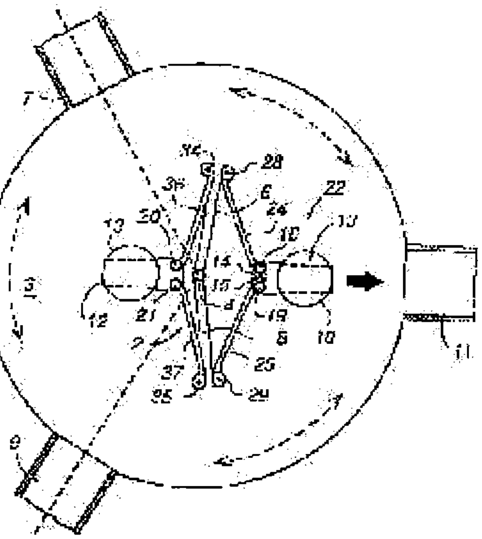
(54) ROBOT ASSEMBLY

(57)Abstract:

PURPOSE: To provide a robot for handling a semiconductor wafer simple in construction, low in manufacturing cost and high in handling ability.
CONSTITUTION: This robot assembly 2 having a central hub 4 is provided with two arms 6, 8 constituted so as to independently rotate about the central hub 4. Two carriers 12, 13 oriented 180° apart from each other, are coupled to an end of each of the arms 6, 8. A drive device is provided for rotating the arms 6, 8 in opposite directions to extend one or the other of the carriers 12, 13 radially from the central hub 2, and by rotating the arms 6, 8 in the same direction to effect rotation of the carriers 12, 13.



LEGAL STATUS

[Date of request for examination] 08.06.1993

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than

the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2131802
[Date of registration]	29.08.1997
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	09.08.2003

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to a robot. Furthermore, this invention relates to the robot assembly which deals with two or more objects, for example, a semiconductor wafer, to coincidence in detail.
[0002]
[Description of the Prior Art] Or the handling by human being is inefficient-like (reaching), when not desirable, the policy on the manufacture enough established on application uses a robot arm. For example, in semiconductor technology, a wafer is handled in the step of various processes using a robot arm. The possibility of contamination is restricted, in order to guarantee that various specific processing conditions are set up, a seal environment must be held to the step of such a process, for example, the step of the process generated in reaction chambers, such as etching, deposition, and passivation, is contained in it. In plaque TISU performed now, the robot arm is used for loading a semiconductor wafer to various processing ports from a loading port within a multiplex chamber reaction system. Next, after processing a robot arm within the chamber of a related process, it is used for taking out a wafer from a specific port. This wafer is moved to the next port by the robot arm next for another processing. After all processings in this reaction system are completed, as for a robot arm, a semiconductor wafer is returned to a loading port, and the following wafer is laid in a system by this robot arm for processing. Generally, the stack of working [of each process] and the semiconductor wafer of ****** is handled by such approach.
[0003]
[Problem(s) to be Solved by the Invention] It is desirable to have two or more semiconductor wafers in process in coincidence in a multiplex chamber reaction system. Thus, the maximum throughput is acquired using a reaction system. Technically, the robot arm used by the reaction system must keep one wafer, must take out another wafer, must lay it, and must take out and lay the wafer which was being kept next. Although a reaction system use is improved by this, therefore a throughput is improved, the robot arm itself must repeat repetitive actuation frequently. The one approach of canceling the non-effectiveness which accompanies such useless actuation is providing coincidence with the robot arm which has the capacity which handles two wafers. Therefore, the equipment manufacturer of ****** offers the robot arm which two carriers rotate centering on a fixed pivot by the end of an arm by the motor which has a belt driving gear. By this approach, the 2nd wafer can be kept on the carrier of another side, taking out and laying the 1st wafer using one carrier. These carriers can be rotated next and the wafer which was being kept can be laid according to hope. Such a device is quite complicated, and it needs a large-sized arm assembly in order to support the weight of the carrier driving gear located in the edge of an extensible robot arm. For example, three driving gears are usually required for the system which contains such a robot arm. That is, one driving gear is for rotating an arm, one arm is for expanding this arm, and one arm is for rotating these carriers. Therefore, by following, all improvements of a throughput to which such a carrier is performed by two or more robot arms pay a manufacture

increase in cost, the increment in weight and power consumption, the increment in complexity, and dependability and the sacrifice of the degradation in service offered, and are attained.

[0004] In other approaches which offer two or more robot arms, a carrier lays two robot arms in the same axle focusing on a common swivel. When each arm of this robot operates independently with the arm of another side and the handling capacity of this system increases it, a throughput can be made to increase, namely, two arms are superior to one arm. However, it is not easy to prepare two robot arms which operate independently centering on a common shaft. Therefore, it is necessary to prepare two or more driving gears and a shaft with rigidity, and by this, a manufacturing cost and complexity increase again and, on the other hand, dependability falls.

[0005]

[Means for Solving the Problem] This invention is a robot assembly which has the central hub in which two arms were prepared. Each arm is constituted so that it may rotate to this hub. Two carriers which opened spacing mutually are formed and various objects like a semiconductor wafer are handled. Each carrier is combined with the end of each arm. A driving gear is formed, these arms are mutually rotated in the reverse direction, radial is made to elongate the carrier of one side or another side from a central hub, both arms are rotated in the same direction, and a carrier is rotated centering on this hub. In the case of a suitable example, one arm is rotated using the 1st driving gear, and the arm of another side is rotated using the 2nd driving gear. This direction or hard flow is made to rotate these arms by synchronizing drive actuation.

[0006]

[Example] He can understand this invention best by referring to a drawing in relation to this specification. This invention is a robot assembly which handles two or more objects. In the suitable example, the application of this invention is the reaction system which is used for manufacture of a semi-conductor. For example, this invention is useful although a wafer is inserted and taken out through the port of a reaction chamber. By this invention, two objects like a semiconductor wafer can be handled to coincidence, it is possible insertion, ejection, or to make it rotate, consequently one wafer can be kept to a robot assembly, and the wafer of another side can be laid. The throughput under wafer processing can be made to increase to keeping a wafer according to this new description as compared with the robot assembly by the conventional technique in which it must pass through the whole cycle of handling. Thus, a wafer is processed, using a reaction chamber continuously, i.e., there is no generating of the dead time, like the system of the conventional technique, a wafer [finishing / processing] is returned to a stack and, on the other hand, a "new" wafer is taken out. When using it with the processing configuration of a daisy chain mold (i.e., when using a multiplex reaction chamber for a series of processing steps continuously), the same advantage is acquired by this invention.

[0007] Drawing 1 relates the top view of the robot assembly 2 with the reaction system 3, and shows it. The robot assembly 2 is constituted by the core in the reaction system 3, and moves a semiconductor wafer 13 from these reaction chambers as opposed to reaction chambers 7, 9, and 11. Although this typical example of this invention indicates the robot located at the core in a reaction system and this reaction system has three reaction chambers, care about having the intention of applying this invention also to the example from which many differed. Therefore, this invention is limited by this typical example and it should not think according to it. That is, this invention can be easily applied to any applications which handle the wafer containing a reaction system, any number of number of the reaction chambers of a ****** system may be good, and any are sufficient as the direction over a robot assembly.

[0008] The robot assembly 2 has the 1st arm 6 and the 2nd arm 8, and the end of each arm is combined with the central hub 4. Each arm can be rotated to a clockwise rotation or a counterclockwise rotation independently of the arm of another side centering on a hub 4. Therefore, these arms can be rotated in both directions contrary to the same direction. Which source [like] of power which is one set or two or more sets of motors may perform rotation. This source of power must be constituted so that either hard flow or this direction may be made to rotate arms 6 and 8 possible [reversal]. In the suitable example of this invention, these arms are pivotable independently on the same axle centering on a hub, and this

source of power is the motor combined magnetically [the class currently indicated by the United States patent application number No. 644,852 under connection for which it applied on January 22, 1991 which is continuation application of the United States patent application number No. 424,771 for which it applied on October 20, 1989 by which current abandonment is carried out]. It is transferred to Applied Materials (Applied Materals, Inc.) any the application of whose is the grantee of this application. Each arms 6/8 have the fixed pivot (it is 28 and 29, respectively) prepared in the edge combined with the hub 4, and the edge of this arm of the opposite side. These arms are combined with struts 24/25 possible [revolution]. These struts are combined with the 1st wafer carrier 10 with fixed pivots 18/19 this time. Each strut has the gears 14/15 which gear by the end in a carrier 10, and when these struts circle working [a robot assembly], it may hold them in the condition of having made radial adjusting this carrier 10 firmly with a hub 4. The example of ****** of this invention may be substituted for these engagement gears 14/15 by the belt of the typeface of 8, if you wish.
[0009] The arm shown in drawing 1 and linkage form the compound joint device sometimes called a machine technique top frog-leg (foot of frog) device. or [that drawing 1 hands over a wafer from a reaction chamber] -- or in order to take out, the location elongated partially shows the carrier 10. The 2nd wafer carrier 12 is also shown in drawing 1 , and arms 6/8 are combined with these struts 36/37 in this case with the fixed pivots 34/35 located in the end of struts 36/37. Struts 36/37 are combined with the carrier 12 with the fixed pivots 20/21 located in the other end of these struts. A carrier 12 is linked to arms 6/8 by the same approach as a carrier 10, consequently centering on the shaft of a hub 4, these two carriers leave 180 degrees mutually, and are held so that it may discuss enough [further] below.
[0010] Drawing 2 is the detail up top view of the robot assembly 2, shows one carrier 10 in the location elongated partially, and shows the carrier 12 of another side in the location which retreated partially. The arrow head in drawing shows relative movement of the arms 6 and 8 centering on a hub 10. The carrier 10 is combined with arms 6/8 by struts 24/25. By operating the fixed pivots 18/19 of a carrier 10, and the fixed pivots 28/29 of arms 6/8, struts 24/25 are constituted so that it may rotate synchronizing with arms 6/8. The carrier 12 is combined with struts 36/37 possible [revolution] with fixed pivots 20/21 next. Struts 36/37 are combined with arms 6/8 possible [revolution] with fixed pivots 34/35.
[0011] Although arms 6/8 are illustrated as what has two fixed pivots respectively, it must care about that it can constitute easily so that these carriers and struts may share one swivel on each arm. Such a configuration is shown in drawing 3 , and in this case, arms 6/8 are constituted so that it may circle centering on a hub 4 by the end of these arms. One swivels 40/42 are contained in the other end of each arm, respectively. These arms are respectively combined with two struts by swivels 40/42, and one strut supports each carrier. Therefore, the arm 6 is combined with the strut 36 (for carriers 12) of another side while being combined with one strut 24 (for carriers 10) by the swivel 40. On the other hand, the arm 8 is combined with the strut 37 of another side while being combined with one strut 22 (for carriers 10) by the swivel 42.
[0012] Actuation of this invention is shown in drawing 4 , and 5 and 6. Drawing 4 shows the robot assembly 2 which has received the circular movement of both carriers 10/12 in coincidence centering on the hub 4, as the arrow head of this drawing shows. In order to perform such rotation, it rotates independently to a clockwise rotation or a counterclockwise rotation centering on a hub 4, and carriers 10/12 are in the equal distance from a hub 4 at this point until these arms leave 180 degrees of arms 6/8. Next, rotation of these carriers is performed the same direction, for example, by rotating the arms 6/8 both clockwise. This turning effort is transmitted to carriers 10/12 through related struts 24/25 and 36/37 related. Drawing 5 shows actuation of a robot assembly, and in this case, the 1st carrier 10 retreats and is elongating the 2nd carrier 12. As an arrow head shows, by movement of each counterclockwise rotation/clockwise rotation of the arms 6/8 centering on a hub 4, it pulls to struts 24/25, and the force is applied and one carrier 10 is pulled toward a hub 4. In coincidence, by arms 6/8, it pushes against struts 36/37, the force is added, and the carrier 12 of another side is pulled apart from a hub 4.
[0013] Drawing 6 shows actuation of a robot assembly, and in this case, the 2nd carrier 12 retreats and is elongating the 1st carrier 10. As an arrow head shows, by movement of each clockwise rotation/counterclockwise rotation of the arms 6/8 centering on a hub 4, it pulls to struts 36/37, and the

force is applied and one carrier 12 is pulled toward a hub 4. In coincidence, by arms 6/8, it pushes against struts 24/25, the force is added, and the carrier 10 of another side is pulled apart from a hub 4. This invention is useful although two or more objects are dealt with. As mentioned above, the application of the suitable example of this invention is a reaction system for processing a semiconductor wafer. A carrier 10 is shown as a thing in an expanding location by drawing 1 , and the carrier 12 of another side is shown as a thing in a retreat location. Therefore, a carrier 10 can keep a semiconductor wafer using the carrier 12 of another side, while having taken out the semiconductor wafer 13 from the reaction chamber 11.

[0014] On actuation, a robot arm takes out a wafer from the stack of a wafer, and lays this wafer in a reaction chamber. Next, a robot arm takes out the 2nd wafer and, on the other hand, the 1st wafer has stopped at a reaction chamber. After sufficient processing time passes, the 1st wafer is taken out from a reaction chamber, and a robot arm holds two wafers at this time, and another side is new. [these one] [processing] If it is in the location of drawing 3 , these carriers will rotate, consequently the new wafer of one carrier will be laid in a reaction chamber, and, on the other hand, a wafer [finishing / the processing on the carrier of another side] will be returned to the stack of a wafer. Next, a robot arm loads other new wafers from the stack of a wafer, and returns to a reaction chamber. The process explained now is repeated if needed. Furthermore, the robot arm of this invention is easily applicable also to the process of the daisy chain mold which a wafer moves continuously through a series of reaction chambers as a part of flow of a process.

[0015] On the other hand, in the robot assembly of the conventional technique, for above-mentioned actuation, the 1st wafer must be removed from a reaction chamber and must be returned to the stack of a wafer with a robot assembly for storage. Next, the 2nd wafer is taken out using a robot assembly and this is laid in a reaction chamber. A reaction chamber will be in an idle state between spacing of storage of the 1st wafer and installation into the reaction chamber of the 2nd wafer. By this dead time, the throughput of a reaction system declines sharply. Therefore, this invention moves a wafer within a semi-conductor reaction system, and reduces the handling in the case of exchanging this wafer for a new wafer, and the number of steps, therefore heightens a throughput (movement of an unnecessary and useless robot assembly is removed).

[0016] Although this invention was explained with reference to the suitable example of a robot assembly, this contractor understands easily that applications other than an application including handling of the semiconductor wafer in a reaction system and other handling schedules, a configuration, etc. can be replaced with and applied to what was explained here, without deviating from the pneuma and the range of this invention. For example, it is not necessary to make an arm exercise independently on the same axle centering on a hub. Various movements can be made to perform rather, without deviating from the pneuma and the range of this invention. Therefore, this invention should be limited by only the publication of a claim.

[Translation done.]